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11:45 Direct wafer bonding for heterogeneous integration

Authors : V. Dragoi, N. Razek, C. Flötgen, M. Wimplinger, M. Eibelhuber, T. Uhrmann

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Resume : Emerging "More than Moore" and photonic application benefit tremendously by close integration of compound semiconductor materials. Heterogeneous integration allows combining one to combine the benefits of mature Si silicon technology and the superior properties of compound semiconductor materials. This leads to significant performance increases or novel capabilities at comparatively low costs. This demand for integration is not limited to CMOS wafers and can be extended to economically preferred substrates in general. Epitaxial growth of compound semiconductors on e.g. silicon substrates has made substantial progress; however, the high defect rates at the growth interface, the slow growth rate of the material from the epitaxial process, and the cost of the epitaxial equipment remain very challenging. Thus wafer bonding is identified as one of the key processes to meet the needs for heterogeneous integration of compound semiconductors. This paper will focus on direct bonding methods, process requirements for combining different materials and resulting bond strength and interface properties. Besides a short overview about the status quo of plasma activated direct bonding it will explore on new technologies as oxide free wafer bonding with electrically conductive interfaces. This process is enabled by removal of the undesired oxide layer with a dry process utilizing energized particles and bonding in a high vacuum chamber.

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12:00 Increase of Surface Roughness and Phonon Scattering Mediated Spin Lifetime in Thin Strained SOI Film

Authors : Joydeep Ghosh, Dmitry Osintsev, Viktor Sverdlov, and Siegfried Selberherr

Affiliations : Institute for Microelectronics, TU Wien

Resume : Silicon, the main element of microelectronics, appears to be the perfect material for spin-driven applications. Purely electrical spin injection in silicon from a ferromagnetic contact at room temperature has been successfully demonstrated. The spin lifetime in bulk silicon is limited by phonon-assisted electron scattering between non-equivalent valleys. In bulk silicon biaxially stressed in the (001) plane the valley degeneracy is partly lifted which results in a several times spin lifetime enhancement depending on the spin injection orientation. However, experimentally observed large spin relaxation in confined (001) silicon structures, where the valley degeneracy is lifted in a similar fashion, demands a deeper understanding of the fundamental spin relaxation mechanism in UTB films. Spin relaxation mechanisms due to surface roughness and acoustic phonons determine the spin lifetime in (001) films. The spin lifetime is limited by electron transitions between the equivalent unprimed subbands. Shear strain due to tensile stress in [110] direction lifts the degeneracy between the two equivalent unprimed subbands in a controllable way. This reduces the main component of the spin relaxation due to inter-subband scattering. We also demonstrate an increase of the spin lifetime, when the spin injection direction is gradually drawn from perpendicular to the film towards in-plane. This work is supported by the European Research Council with grant #247056 MOSILSPIN.

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12:15 Thermal strain distribution around Through Silicon Vias in Silicon-On-Insulator for photonics applications in 3D integrated devices

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Resume : Thermal strain is known to occur in silicon around Through Silicon Vias (TSVs), due to the coefficient of thermal expansion mismatch between Cu and Si. In parallel, new trends in 3D Integration imply the fabrication of Si photonic devices like waveguides in Silicon-On-Insulator (SOI) substrates